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1. Introduction

Adolescence is a time of discovery and experimentation. It is also a period of physical and mental development when small changes can impact on the rest of a person's life. Adolescence is also the time when a large proportion of teenagers try alcohol(Smyth, Kelly, & Cox, 2011; Vega et al., 2002), tobacco(2002), and cannabis(Vega, et al., 2002) for the first time. Use of these substances during this period can often be detrimental to normal adult growth(Gruber, Sagar, Dahlgren, Racine, & Lukas, 2011; Tucker, 2009) and may result in chronic use leading to long-term health problems and early death(Schuppan & Afdhal, 2008). The number of deaths attributable to addictive substances worldwide in 2004 was estimated to be over seven and a half million people(World Health Organisation, 2009). The same report showed that in Europe, 22.5% of all deaths in the region were directly caused by addictive substances, the highest percentage in any World Health Organisation (WHO) region in the world. There were 65,087 recorded drug-induced deaths due to illicit drugs alone in European Union (EU) member states between 2000 and 2008; with approximately 16% of those deaths occurring in under 25s (EMCDDA, 2011).

Ireland is similarly affected by substance use. Approximately 287 adolescents under the age of 19 years died in Ireland between 1998 and 2009, due to or as a consequence of substance use(Health Research Board, 2010, 2011a, 2011b). These statistics highlight the magnitude of substance use amongst the adolescent population in Ireland. Substance use in Ireland has been on the rise over the past decade; lifetime use of any illegal substance has risen by nearly 10% in the 15-34 years age category. Increased use of cannabis (up 9.6% to 33.4%) and cocaine (doubled to 9.4%) are the most concerning trends identified from a recent report from the National Advisory Committee on Drugs (NACD)(National Advisory Committee on Drugs, 2011). A recent survey from United Nations International Children's Emergency Fund (UNICEF) reported that 38% of Irish 18-year-olds have taken drugs (defined in this survey as any substance except alcohol or tobacco) at some stage in their lives, and it rose to 44% for 20 year-olds(UNICEF Ireland, 2011). In the same survey, when asked if they were currently taking drugs, 28% admitted that they were.

This widespread substance use in Irish society is placing an undeniably large burden on resources. Between 2005 and 2010, there were 2,295 recorded cases of adolescents under the age of 18, who utilised a drug treatment centre for the first time(Bellerose, Carew, & Lyons, 2011). This reflects an increase of over 50% in treatment demand over this five-year period. Large amounts of public funds and manpower have been invested in reducing availability of illegal substances in our society. Figures from the Central Statistics Office

*Highlights (for review)

- Systematic review of levels of drug use in Irish 13-24 year olds from 2000.
- Drugs included in the review are tobacco, alcohol, cannabis and benzodiazepines.
- Tobacco, alcohol and cannabis levels have mostly fallen over the review period.
- Benzodiazepine levels have been generally static over the review period.

(CSO) show that the number of cases of “possession of drugs for personal use” in 2010 was 14,523, which is more than double the figure for 2004(Central Statistics Office, 2011). This database also shows a similar rise in the recorded number of cases of “possession of drugs with intent to supply”; 4,159 reported in 2010, almost twice the level recorded in 2004. There appears also to be a sharp increase in the domestic production of these substances to supply the high level of demand. In the same period of time as above, there was a 14-fold increase in the number of cases of “cultivation or manufacture of drugs”. This is a substantial challenge to the resources of An Garda Síochána, (Irish national police force). There are presently over 400 Gardaí involved in the Garda National Drugs Unit and in divisional units solely working to combat drug crime(C. Byrne, 2011).

Persons who start experimenting with substances at an early age are more likely (i) to engage in polysubstance use(Lewinsohn, Rohde, & Brown, 1999), (ii) to have problem use later in life(Chen, Storr, & Anthony, 2009; Dawson, Goldstein, Chou, Ruan, & Grant, 2008), (iii) to suffer from health problems(Hart, Morrison, Batty, Mitchell, & Davey Smith, 2010), and (iv) to experience psychological problems(Tucker, 2009). Preventing or delaying the onset of experimentation could reduce the number of persons requiring medical treatment; thus potentially reducing the burden on the public health care system, and related healthcare expenditure. Furthermore, it would likely lead to a decrease in polysubstance use, which has been associated with increased mortality(Gossop, Stewart, Treacy, & Marsden, 2002) and has been implicated in approximately 50% of all substance-related deaths in Ireland between 2004 and 2009(Health Research Board, 2011a).

The prevalence of substance use and the harm that is caused by young people is an area of concern for policy makers, health workers, the criminal justice system, youth workers, teachers and parents. It is therefore important to have a clear understanding of the extent of the problem. Whilst there have been studies which have examined this issue, there has not been a comprehensive review of the literature relating to substance use by young people in Ireland. We have therefore conducted a systematic review, to identify, synthesise and summarise the existing literature on the prevalence of substance use among adolescents and young adults in Ireland. The review will look at prevalence figures for the four most-used substances across the Republic of Ireland for persons between the age of 13 and 24, and compare usage across the years studied, 2000-2012.

2. Methods

This review was produced according to Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines for systematic reviews and meta-analyses (Moher, Liberati, Tetzlaff, Altman, & The, 2009). These guidelines are primarily used for the reporting of controlled randomised trials (RCTs) or intervention studies, and so while not all items were applicable to this review of prevalence studies, the guidelines were adhered to as closely as possible. The articles were compiled from a large number of databases to ensure that as many relevant articles were included. The review was limited to articles reporting the use of cannabis, alcohol, nicotine, and benzodiazepines. These four substances were identified as the most widely-used substances in two recent large-scale studies (Currie et al., 2008; B. Hibell et al., 2009). An age range of 13-24 years was used as the criteria for searching as it encompasses the National Library of Medicine's Medical Subject Headings (MeSH) definitions of an 'adolescent' (13-18 years) and 'young adult' (19-24 years) (National Center for Biotechnology Information, 2011). The following inclusion criteria were applied to the searches: English language, full-text access, and published since 2000. The databases searched with a Boolean string were: PubMed, Scopus, Web of Knowledge, Google Scholar, ERIC, Embase and CINAHL. The PubMed database was searched using the keywords as follows: *adolescent or young adult, marijuana smoking, benzodiazepines, smoking, ethanol, Ireland*. A search of the remaining databases was performed including the search terms: *adolescent or young adult, cannabis or marijuana or benzodiazepine or alcohol or nicotine or tobacco or cigarette, and Ireland*. These searches were conducted in December 2011 and updated thereafter to include relevant studies that were published after December 2011. An additional manual search of the National Documentation Centre on Drug Use was necessary as it did not allow searches using Boolean operators (Health Research Board, 2011c). This website is controlled by the Health Research Board (HRB) in Ireland and is a "database of Irish drug and alcohol research – an electronic library of full-text reports, journal articles, theses, and conference papers" (National Documentation Centre on Drug Use, 2012). This database has links to grey literature published by the government, national and international bodies. Personal contact was made with authors of some articles to obtain additional information.

The eligibility of articles found by the database search was checked by searching the title and abstract of the articles. Duplicates and records that were found to be not relevant were excluded. Reasons for exclusion included: multiple papers publishing data from the same dataset, articles which were commentaries and not original research, articles which covered a range of ages but were not divided into age categories, and articles which were part of a

multi-national study, but did not provide country-specific information for Ireland. If there was still doubt about the eligibility of a paper, it was included so that a detailed inspection could be done at the next stage. The next stage was to obtain full-text copies of the remaining articles, and do a further assessment for eligibility and relevance. The data points of interest were extracted from the full-text reports and compiled into summary tables (see Tables 1-5). The data points assessed were divided into two categories: study characteristics (sample size, sampling method, age range, region of sampling, and any other information that might influence the analysis of the survey), and study results (details of alcohol, tobacco, cannabis, and benzodiazepines). These study results would be the outcomes of interest for the review.

Quality of the final articles was assessed using the Methodological Index for Non-Randomised Studies (MINORS) tool (Slim et al., 2003). The tool was customised for use in this review, and all the articles retrieved were assessed in a scale of 0-10 based on their methodological quality. The scoring of the studies can be seen in Table 1.

3. Results

A total of 2,562 articles were found in the database search, and 11 were found in additional searches. The titles and abstracts for each article were reviewed and duplicates were removed. This reduced the number of remaining articles to 1,773. The next stage was to examine the title and abstracts of the remaining articles and eliminate those which did not match the eligibility criteria. 1,702 articles were discarded; 360 were excluded because the study wasn't investigating Irish young people, 1309 were excluded because they were not measuring drug prevalence, 10 were excluded because they measured prevalence in a different age group, 18 were excluded because they weren't original research i.e. editorials, literature reviews etc., and 5 were excluded because they were studies that were based on data used from previous studies. After the excluded articles were discarded, 71 remained. The full-text articles were then obtained and assessed for suitability. Fifty-four articles were excluded; 8 had no Ireland-specific data, 36 weren't substance use prevalence studies, 7 had data from studies with age ranges that included ages over 24, 2 had data based on previous research, and 1 wasn't a research article. There were 18 articles included in the review. A PRISMA flow diagram (Figure 1) provides a summary of the stages, and the number of studies in each stage (Moher, et al., 2009). The study characteristics for the papers included in the review are summarised in Table 1. One of the included studies was a randomised control trial (RCT) that measured the effect of a smoking prevention initiative (Share, Quinn, & Ryan, 2004). There were eleven observational studies that had partial or full randomisation in the sampling process (Currie, et al., 2008; Flanagan, Bedford, O'Farrell, & Howell, 2003; Björn Hibell et al., 2004; B. Hibell, et al., 2009; Björn Hibell et al.,

2012; Kabir, Manning, Holohan, Goodman, & Clancy, 2010; Kelleher, Cowley, & Houghton, 2003; Manning et al., 2002; McNeill et al., 2011; Office of Tobacco Control, 2006; Smyth, et al., 2011), and one study employed cluster sampling(Morgan et al., 2008). Convenience sampling was used by three of the studies(O'Cathail et al., 2011; Palmer & O' Reilly, 2008; UNICEF Ireland, 2011), and the method of sample selection could not be identified in two studies(Curtin, 2004; Moran, Maguire, & Howell, 2000). Half of the studies surveyed the use of a single substance while the majority of the remaining studies investigated the use of three or more substances. Sixteen studies had tobacco as a substance studied, eleven studies investigated alcohol consumption, nine studies looked into cannabis use, and six investigated benzodiazepine use.

To facilitate observation of trends over time, the studies are presented according to three time periods: Period 1 (2000-2006), Period 2 (2007-2009), and Period 3 (2010-2012). As fewer studies were published in the earlier years, Period 1 encompasses a longer timeframe of 7 years. Period 2 and 3 have equal timeframes of 3 years. These groupings provided approximately equal-sized groups, in terms of numbers of publications thereby avoiding issues such as diluting the group size to one or two articles.

3.1. Tobacco Usage

There were sixteen studies which collected data on tobacco usage, and a summary of the data can be seen in Table 2. One study was a RCT(Share, et al., 2004), eleven were observational studies with randomly selected participants(Currie, et al., 2008; Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Kabir, et al., 2010; Kelleher, et al., 2003; Manning, et al., 2002; McNeill, et al., 2011; Office of Tobacco Control, 2006), one study used cluster sampling(Morgan, et al., 2008), two used convenience sampling(O'Cathail, et al., 2011; UNICEF Ireland, 2011) and two did not describe how participants were selected(Curtin, 2004; Moran, et al., 2000).

Lifetime use of tobacco

This was reported in over half of the studies.

Period 1 (2000-2006): The levels from five studies in Period 1 ranged between 50-67%(Curtin, 2004; Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003; Share, et al., 2004). The variation in the levels may exist because four of the five studies were measuring regional populations. The only national study reported a lifetime usage level of 67%(Bjorn Hibell, et al., 2004). The largest of the regional studies reported a similar figure

at the high end of the range, 61%, and so the true estimate probably lies in the somewhere in this region(Kelleher, et al., 2003).

Period 2 (2007-2009): Two studies in Period 2 surveyed lifetime use: one of the studies measured usage in 13 year-olds and 15 year-olds and reported 26% and 50% respectively(Currie, et al., 2008), while the second study reported 52% in a survey of 15-16 year-olds(B. Hibell, et al., 2009) Both of these studies were on a large scale and encompass national populations so their estimates would be close to the true figure.

Period 3 (2010-2012): There were two studies from Period 3, and these studies estimated lifetime tobacco usage at 48% and 43% respectively. There were differences between the two studies however, the former study was conducted in Cork City(O'Cathail, et al., 2011) while the latter was a nation-wide study(Björn Hibell, et al., 2012).

Smoking a cigarette by age 13 years

The second category examined was smoking a cigarette by age 13 years. It has been shown that initiation of substance use prior to 13 years of age is associated with chronic substance use(Hawkins et al., 1997). There were seven studies that collected data on this.

Period 1 (2000-2006): Four studies were published with results which ranged from 30-50%(Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003; Share, et al., 2004)

Period 2 (2007-2009): Two studies were published which both had similar levels of approximately 30%(Currie, et al., 2008; B. Hibell, et al., 2009). These studies had good study designs and used a national sample so the true level is likely to be close to this.

Period 3 (2010-2012): A single study published reported a level of 21%(Björn Hibell, et al., 2012).

Smoking in the previous month.

The third category examined was smoking in the previous month. This is considered a good indicator of regular use.

Period 1 (2000-2006): The studies from Period 1 ranged from 19-39%(Curtin, 2004; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003; Manning, et al., 2002; Moran, et al., 2000; Office of Tobacco Control, 2006; Share, et al., 2004). Some of the variation in this can be explained thus: the two studies with the lowest percentages, 19% and 21%, were phrased in a different manner(Manning, et al., 2002; Share, et al., 2004). They measured positive responses to a

question relating to whether they were currently smoking. This is not a clearly defined question and may account for the lower percentage. Two of the studies did not clearly indicate how samples were picked (Curtin, 2004; Moran, et al., 2000), and so caution is advised when generalising the results from these studies. The final two studies gave estimates of smoking in the previous month to be 33% and 30% respectively, so the true level is likely to be near this figure (Bjorn Hibell, et al., 2004) (Kelleher, et al., 2003).

Period 2 (2007-2009): The level of smoking in the previous month in Period 2 was measured in two studies, and was estimated to be 23% (B. Hibell, et al., 2009) for one and between 29 and 40% for the other (Morgan, et al., 2008). The study was a large-scale, nationwide survey, and it is likely that the result is indicative of the true figure.

Period 3 (2010-2012): Five studies were found from Period 3; it is difficult to make a direct comparison between them due to significant heterogeneity in the studies. Two studies recorded levels of 10.6% and 10.5% for 13-14 year-olds (Kabir, et al., 2010) and 13-15 year-olds (McNeill, et al., 2011) respectively, even though the former study measured the percentage of young persons currently smoking, and the latter measured the percentage of young persons that smoke greater than once a week or more. Two studies measured the level in older adolescents, 15-17 year-olds and 16-20 year-olds and reported levels of 18% (O'Cathail, et al., 2011) and 23% (UNICEF Ireland, 2011) respectively. Both of these studies however used convenience sampling to select their participants. The remaining study from Period 3 looked at 15-16 year-olds, and showed a level of 21% (Björn Hibell, et al., 2012).

Daily tobacco use

The final category examined was daily tobacco use.

Period 1 (2000-2006): The range in data from Period 1 was 11-23% (Curtin, 2004; Flanagan, et al., 2003; Moran, et al., 2000; Share, et al., 2004). However, caution should be exercised when interpreting results of the studies reporting the two highest levels, 23% (Moran, et al., 2000) and 19% (Curtin, 2004), as the method of sample selection was not specified in the paper. The remaining two studies had good design; however they were both regional studies and so may not give a good indication of the national estimate.

Period 2 (2007-2009): There were two studies from Period 2 and both studies reported two levels; the first study reported one for 13 year-olds, 3%, and one for 15 year-olds, 15% (Currie, et al., 2008). The second study reported on levels of 18-19 year-olds, 23%, and

20-24 year-olds, 31%(Morgan, et al., 2008). These are nationally representative studies and have good design so it is likely that they approximate the national level closely.

Period 3 (2010-2012): None of the studies from Period 3 reported levels of daily smoking.

3.2. Alcohol Usage

There were eleven studies that looked into alcohol usage and a summary is provided in Table 3. Randomised sample selection was used in seven of the studies(Currie, et al., 2008; Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Kelleher, et al., 2003; Smyth, et al., 2011), convenience sampling was used for two(Palmer & O' Reilly, 2008; UNICEF Ireland, 2011), cluster sampling in one study(Morgan, et al., 2008), and the method of sample selection was not described in one of the studies(Curtin, 2004).

Lifetime use of alcohol

For lifetime use of alcohol, the figures varied both between and within these periods.

Period 1 (2000-2006): There were four studies published in Period 1, and their levels ranged from 71-92%(Curtin, 2004; Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003). Differences in levels in these studies can in part be attributed to the age range of the participants. The studies with the lowest figure had a participant age ranging from 12-19 years, while each of the others studies had a minimum age of 14 or 15 years. One of the studies reported a lifetime level of 82%, but this study was conducted in County Cork with an unknown method of sampling, so it is difficult to extrapolate from it(Curtin, 2004). Two studies demonstrated close agreement at 92% and 90% levels for lifetime usage and the true level is likely to be close to this(Bould et al., 2007; Bjorn Hibell, et al., 2004).

Period 2 (2007-2009): Only two of the three studies in Period 2 had data relating to lifetime alcohol usage and both of those studies reported similar results: 86.1% and 86%(B. Hibell, et al., 2009; Palmer & O' Reilly, 2008).

Period 3 (2010-2012): There were three studies published in Period 3 and they reported 77%, 58% and 81% usage (Björn Hibell, et al., 2012; Smyth, et al., 2011; UNICEF Ireland, 2011). The wide discrepancy between these figures may be due to the age of participants; up to 20 years in one study(UNICEF Ireland, 2011) and up to 16 years for the latter 2 studies. Another reason could be the nature of the studies: one was an internet poll and this may be a source of bias in the study(UNICEF Ireland, 2011). This contrasts with the third study which was a national study with randomised sampling(Björn Hibell, et al., 2012).

Consumption of alcohol before 13 years of age

Period 1 (2000-2006): This examined the percentage of young persons who first consumed alcohol before 13 years of age. A limitation with this category was that it was reported in only two studies. Unfortunately, one of the studies quoted percentages for three types of alcohol (beer, wine, and spirits) which ranged from 32-47%, so it was not possible to get an overall figure (Bjorn Hibell, et al., 2004). The remaining study reported an overall consumption level of 50% (Kelleher, et al., 2003).

Period 2 (2007-2009): two studies from Period 2 reported on this category. One of the studies differentiated between alcohol types, which ranged from 21-33% (B. Hibell, et al., 2009). The other study, Currie *et al.*, reported a level of 38% (Currie, et al., 2008). Both of the studies were well-designed and were probably an accurate reflection of the actual population level.

Period 3 (2010-2012): A single study from Period 3 reported levels of first consumption prior to 13 years of age at between 18% and 40% for the three types of alcohol mentioned above (Björn Hibell, et al., 2012).

Alcohol use in previous 12 months

Alcohol use in the previous 12 months was used as a measure of occasional use. Five studies (two from Period 1, two from Period 2, and one from Period 3) included data on 12 month usage (Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Kelleher, et al., 2003; Palmer & O' Reilly, 2008).

Period 1 (2000-2006): Both studies reported similar values, 88% and 83% (Bjorn Hibell, et al., 2004; Kelleher, et al., 2003). Both studies were large scale and had good design, so it probably reflects an estimate of the population figure.

Period 2 (2007-2009): The two studies from Period 2 were in broad agreement with each other. Hibell *et al.* and Palmer *et al.* reported levels of 78% and 83% respectively (B. Hibell, et al., 2009) (Palmer & O' Reilly, 2008). The result from Palmer is a percentage of positive responses to the question if they drank once a year or more.

Period 3 (2010-2012): The single study from Period 3 reported a level of 73% for alcohol use in the previous year (Björn Hibell, et al., 2012).

Alcohol use in the previous month

The final category related to alcohol use in the previous month. Only one of the most recent studies reported data, but there were data from six older papers (three from Period 1, two from Period 2, and one from Period 3)(Curtin, 2004; Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Kelleher, et al., 2003; Morgan, et al., 2008; Palmer & O' Reilly, 2008).

Period 1 (2000-2006): The studies from Period 1 reported a range of levels from 59-73%. The 59% figure comes from the paper by Curtin, which was a small County Cork study and the study design was unknown(Curtin, 2004). This affects the ability to generalise with its data and gives precedence to the results from the other studies which were 73% and 62%(Bjorn Hibell, et al., 2004; Kelleher, et al., 2003).

Period 2 (2007-2009): Hibell *et al.*, 2008 had a level of 56% for the alcohol use in the previous month(B. Hibell, et al., 2009), while Palmer *et al.* gave a level of 62%(Palmer & O' Reilly, 2008). This final figure was the percentage of those that responded positively when asked if they drank alcohol once a month or more often.

Period 3 (2010-2012): The study from Period 3 reported a level of 50% in this category(Björn Hibell, et al., 2012).

3.3. Cannabis Usage

A summary of the studies reviewed that included surveyed cannabis usage is displayed in Table 4. There were nine studies that reported cannabis use amongst adolescents and young adults in Ireland(Currie, et al., 2008; Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Morgan, et al., 2008; Palmer & O' Reilly, 2008; UNICEF Ireland, 2011). The studies were mostly randomised school surveys, while the remaining two studies were convenience studies(Palmer & O' Reilly, 2008; UNICEF Ireland, 2011). All of the studies measured lifetime use of cannabis and there was a wide variation between levels, 20-80%. The two highest usage levels, 80% and 41%, were reported by two studies that used convenience sampling, so the true level may differ(Palmer & O' Reilly, 2008; UNICEF Ireland, 2011). A pattern was seen in the other studies based on their year of publishing.

Lifetime use of cannabis

Period 1 (2000-2006): Earlier studies from Period 1 showed a usage level of between 29 and 39%(Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003).

Period 2 (2007-2009): There were three studies in this period. Two of the studies had a level of 20%(Currie, et al., 2008; B. Hibell, et al., 2009), and the third study had a level of 41.1%(Palmer & O' Reilly, 2008).

Period 3 (2010-2012): There were two studies from Period 3 that reported on lifetime cannabis use. The most recent European School Project on Alcohol and Other Drugs (ESPAD) study reported a level of 18%(Björn Hibell, et al., 2012), while the second report gave separate levels for the dried plant form (weed), >80%, and the extracted resin (hash), 46%(UNICEF Ireland, 2011). These levels are largely different from levels reported at any time throughout the entire time range, and so their use as a representative figure must be cautioned. Overall, the levels are suggestive of a decreasing experimentation with cannabis amongst young people.

Cannabis use in the previous 12 months

A similar pattern was observed in the reporting of cannabis use in the previous 12 months.

Period 1 (2000-2006): Higher levels were observed amongst the earlier studies, 25-31%(Bjorn Hibell, et al., 2004; Kelleher, et al., 2003) than in subsequent periods.

Period 2 (2007-2009): There were four studies in period two and these studies showed a decrease compared to earlier studies to 12-17%(Currie, et al., 2008; B. Hibell, et al., 2009; Morgan, et al., 2008). The exception to this is the study carried out by Palmer *et al.*, which gives a level of 33% for 12 month usage(Palmer & O' Reilly, 2008). A possible explanation for this higher figure may be that the study covers a broader age range (14-19 years), and the level of use generally increases with age. Owing to problems with generalisation of this study, the true level is likely to be closer to Currie *et al.* and Hibell *et al.*(Currie, et al., 2008; B. Hibell, et al., 2009).

Period 3 (2010-2012): A single study from Period 3 reported a level of 14%(Björn Hibell, et al., 2012).

Cannabis use in the previous month

Period 1 (2000-2006): The trends in cannabis use in the previous month paralleled those in use in the previous 12 months. The three studies from period one showed high levels of use, 13-16% (Flanagan, et al., 2003; Bjorn Hibell, et al., 2004; Kelleher, et al., 2003).

Period 2 (2007-2009): There were three studies compared with 7-14% respectively (Currie, et al., 2008; B. Hibell, et al., 2009; Palmer & O' Reilly, 2008). The highest of the more recent figures, (14%) is from Palmer *et al.*, which as mentioned already suggests that the true level may be lower than this (Palmer & O' Reilly, 2008).

Period 3 (2010-2012): There was one study in Period 3 that reported this data and the level was 7% (Björn Hibell, et al., 2012).

3.4. Benzodiazepine Usage

A summary of the studies reporting benzodiazepine usage can be found in Table 5. Four of the six studies had sample sizes greater than 2,000 and participants were randomly selected, so there is a high degree of confidence in the figures reported from these studies (Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Morgan, et al., 2008). None of these studies reported an overall prevalence level for benzodiazepine usage but instead categorised usage into prescription use and non-prescription use. The percentage of subjects who have tried benzodiazepines without the advice of a doctor was consistently higher than prescription use in each of the studies.

Lifetime benzodiazepine use on prescription

Period 1 (2000-2006): There were similar levels for the prevalence of lifetime prescription benzodiazepine use at 9.2% and 10.0% (Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012; Kelleher, et al., 2003). Variation in the figure can be attributed in part to the difference in participant age with one study carried out by Kelleher *et al.* ranging from 13-19 years (Kelleher, et al., 2003) while the rest had a narrower age range. Another contributing factor to the difference was that the participants in the Kelleher *et al.* study were recruited from three counties in the west of Ireland only, while the latter studies selected participants nationwide. This suggests that the higher end of the range is closer to the actual prevalence of non-prescription benzodiazepine use.

Period 2 (2007-2009): There were two studies in this period (B. Hibell, et al., 2009; Morgan, et al., 2008). There was a wide discrepancy between the values gotten in these two studies.

Period 3 (2010-2012): There was only one study in the third period, and this reported a level of use 9.0% (Björn Hibell, et al., 2012).

Lifetime benzodiazepine use without prescription

Period 1 (2000-2006): The levels ranged 2.0% to 5.6%, with the Kelleher *et al.* study reporting a level of 5.6% and the Hibell *et al.*, 2004 study reporting 2%y(Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Kelleher, et al., 2003).

Period 2 (2007-2009): There were 3 benzodiazepine studies that measured lifetime non-prescription benzodiazepine use. Two of the studies had reported differing levels of usage. One of the studies reported a level of 3.0%(B. Hibell, et al., 2009), while the other reports between 0 and 1.4% usage(Morgan, et al., 2008). One of the studies reported both prescription and non-prescription benzodiazepine use at 10.8%(Palmer & O' Reilly, 2008). This level appears to be in agreement with the rest of the studies; however the study cohort was not a national sample nor were the participants randomly selected. Both of these factors mean that generalisation of the results is not possible.

Period 3 (2010-2012): There was a single study in Period 3, and it reported a level of 3.0%(Björn Hibell, et al., 2012).

4. Discussion

4.1. Summary of Evidence

This review examined available peer-reviewed research and other available reports on substance use in Irish young people since the year 2000. The review found a variety of studies that ranged from RCTs to online surveys and from small-scale rural studies to national studies. This allowed for a wide perspective on substance use. Some overall trends were observed in the literature. The clearest pattern that was elucidated was a trend towards a decrease in all substance use over time between Period 1, Period 2 and Period 3. This decrease in use was consistent between the first period and the most recent period. An explanation for this trend is not suggested by the majority of authors, though something may be learnt from their observations. One author suggests that the fall in tobacco usage levels may be attributed in part to tighter government restrictions on the sale, display, and usage of tobacco products(McNeill, et al., 2011). A likely significant factor to contribute to Ireland's decreasing substance use rates is the creation and publication of Ireland's first National Drug Strategy document in 2000 (Department of Tourism Sport & Recreation, 2000). It was the first time that a comprehensive and national approach to substance use was examined. There had been a report previous to this, Government Strategy to Prevent Drug Misuse 1991 (Department of Health, 1991), but this had separate strategies for Dublin and the rest of the country. The National Drug Strategy paper introduced for the first time in Ireland the

four pillar system. These pillars are supply, prevention, treatment, and research. This allowed resources to be allocated to areas where they are needed. It allowed “the bringing together of key agencies, in a planned and co-ordinated manner, to develop a range of appropriate responses to tackle drug misuse...” (Department of Tourism Sport & Recreation, 2000). The report resulted in the creation of a National Awareness Campaign which used traditional media such as brochures and radio, and newer forms of promotion i.e. Facebook, Twitter and Drugs.ie website to increase awareness of the effects and consequences of substance use. The most recent National Drug Strategy document (Department of Community Rural and Gaeltacht Affairs, 2009) builds on the determination to lower substance use. The biggest change in this report is the inclusion of alcohol as a drug of abuse. The high level of alcohol use nationally amongst adults and young people, and the cost to the public health system warranted its inclusion. Another stated reason for its inclusion was “For many, alcohol is also seen as a gateway to illicit drug use, particularly for young people, while poly -drug use - which very often includes alcohol - is now the norm among illicit drug users”. A recommendation in the report aimed at school students was the delivery of drug education to primary and post-primary students in schools through the Social, Physical, and Health Education (SPHE) curriculum.

It would appear that the combination of more harsh sales restrictions and increased education and awareness has had its intended effect on drug levels. The efforts of those involved should be applauded, and their support should be continued to maintain this positive trend. This work should be augmented by international good practice such as the WHO’s guidelines on reducing harmful alcohol use (World Health Organisation, 2010). These recommend implement various strategies should as pricing changes, closely regulating the advertisement of alcoholic drinks, and modifying the system of selling alcohol, such as reducing the hours of retails sales, and regulating the number and location of businesses that can sell alcohol. Further reduction in illicit substance use may come from educational interventions as outlined by Faggiano *et al.* 2005(Faggiano et al., 2005) and 2010 (Faggiano et al., 2010). By continuing efforts such as these, the burden of substance use on young people can be reduced.

As stated above, tobacco and alcohol use followed the trend of decreasing use across all measures of use, experimental, occasional, or regular. The fall in levels of use are a positive step in the reduction in the burden caused by “the single most preventable cause of death in the world today”; cigarettes(World Health Organisation, 2008), and reducing the level of total alcohol consumption amongst the Irish, who rank second highest in the EU and 15th highest in the world(World Health Organisation, 2011). Sustaining these trends could result in reduced burden on the healthcare system due to chronic treatment for preventable diseases,

and on the justice system owing to reduced public order violations. The trend in decreasing tobacco use in Ireland mirrors that of Europe. The average lifetime use of tobacco for 15/16 year-olds across the 34 countries included in the ESPAD study fell from 67% to 60% between 2003 and 2007(B. Hibell, et al., 2009). The same report gave a similar description for tobacco use in the previous month, and daily smoking; the former falling from 32% to 28%, while the latter fell from 10% to 8%. An opposite trend was observed in relation to alcohol use. There was no change in the average lifetime use of alcohol from 2003 to 2007(B. Hibell, et al., 2009), and the percentage of 15/16 year-olds who consumed alcohol in the previous month fell from 65% to 62% over the same four-year period. When looking broadly, it is positive to see a reduction of the levels of both experimental and regular use of these widely-available substances when compared to our European counterparts(B. Hibell, et al., 2009).

There was a trend, amongst Irish adolescents, of decreased lifetime cannabis use, use in the previous 12 months, and use in the previous month over the length of the study period(Bjorn Hibell, et al., 2004; B. Hibell, et al., 2009; Björn Hibell, et al., 2012). The pan-European levels indicated by the latter report were similar to the levels of use in Ireland in 2007(B. Hibell, et al., 2009). Ireland differs from the European average however as the level of Irish use decreased while the European level increased from 12% in 2003 to 19% in 2007. Most of this increase can be attributed to countries in the east of Europe, as the United Kingdom, France, Italy, Germany, Norway, Sweden, and Austria also had decreased lifetime cannabis use between 2003 and 2007. A similar pattern was observed in the category of cannabis use in the previous month(B. Hibell, et al., 2009).

Benzodiazepine usage was unchanged across the time periods studied. European levels appear to vary from Irish levels according to the most recent survey of benzodiazepine usage(Björn Hibell, et al., 2012). The estimated average level of illicit benzodiazepine use was 6%, compared to 3% in Ireland. The level of prescribed use of benzodiazepines in Ireland was 1% higher than the European average of 8%. The levels of prescription and non-prescription use in Ireland did not appear to have changed significantly throughout the years of reference of this review. An explanation that may account for the steady level of benzodiazepine use in Ireland is that no campaign on the dangers of inappropriate benzodiazepine usage has been active in the country in the last ten years, since the launch of the Benzodiazepine: Good Practice Guidelines for Clinicians document in 2002. Such a campaign could encourage a young person or their parents to ensure that prescription usage is within safe limits, and deter its illicit use.

4.2. Limitations

A limitation to this systematic review is that the conclusions are only as accurate as the studies it returns. This is a limitation with every systematic review and literature review. To minimise the impact of low quality studies on the review, it was decided to quantify the quality of the studies using the Methodological Index for Non-Randomised Studies (MINORS) tool (Slim, et al., 2003).

An important limitation in the studies in this review was the lack of consistency in survey design. An example of this is evident in Table 2 under the column "Tobacco use in the previous month". It is a standard, internationally-used question used to estimate regular use of a substance. Some studies chose to survey regular use with questions such as "Are you currently smoking?" and "Do you smoke one or more cigarettes each week?" Each question is attempting to measure the same outcome but because of the differences in the actual questions, it makes cross-study comparisons inappropriate and difficult. This limitation affected the ability to make comparisons between studies surveying tobacco, alcohol, cannabis, and benzodiazepine use.

There were few papers found in the literature search that surveyed benzodiazepine usage. A comprehensive search of scientific databases and grey literature could only find five relevant papers. Each of these studies measured usage superficially; one or two questions were asked as part of a section dealing with illicit substance use. It is difficult to get a clear understanding of benzodiazepine usage from these papers. It is important at present to look closer for patterns in benzodiazepine use because it was the only substance in this review whose usage did not appear to be decreasing. This could be the first stage in the development of a targeted educational campaign highlighting the dangers of inappropriate benzodiazepine usage.

There is a category of young person that is excluded from most of the studies in this review. As can be seen in the 'Notes' column in Table 1, twelve of the seventeen studies chose participants from pupils attending the schooling system in Ireland. This method of selection has many advantages; it is more efficient to randomly select young persons around the country, and it saves time because the students are all in the same place at the same time. However, this misses out on early school-leavers, who account for up to 14.1% of school-leavers in total (D. Byrne, McCoy, & Watson, 2008). This cohort of young persons is a significant absence from any study reporting on substance use. International studies have shown that early school-leavers are more likely to use both legal and illegal substances (Townsend, Flisher, Gilreath, & King, 2006). Excluding this group has the potential to underreport the true level of substance use in young persons.

4.3. Conclusions

This review has shown that substance use is still occurring in Ireland. Much of the research that is being undertaken on this topic in Ireland is of high quality and it indicates that the level of use is declining across many substances. However, there is still further work that can be done by policy-makers to ensure that this positive trend will continue. However, the fall in use is not evident with some substances and efforts must be increased to inform the public on their risks. Future work should redress the imbalance in substance use research that sees the majority of researchers looking at a few substances while little work is done on the others. Knowledge derived from these papers and reports, and from future work should guide the development of targeted drug prevention programs that are directed at the sections of population that will benefit the most from them.

5. References

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Table 1: Summary of study characteristics

| Study | n | Region | Age (yr) | Gender (%) | Substance(s) surveyed | Sampling method | MINORS score | Notes |
|---------------------------------|------|---|----------|-------------------------|----------------------------------|--------------------------|--------------|-----------------------|
| Cune <i>et al.</i> , 2008 | 4840 | Republic of Ireland | 11-15 | M: 50.6, F: 49.4 | Alcohol, Cannabis, Tobacco | Stratified random | 10 | a |
| Curtin, 2004 | 348 | County Cork | 15-16 | F: 100 | Tobacco, Alcohol | Unable to identify | 4 | a |
| Flanagan <i>et al.</i> , 2003 | 1426 | Counties Cavan, Louth, Meath & Monaghan | 12-19 | M: 59.7, F: 39.3 | Alcohol, Cannabis, Tobacco | Stratified random | 8 | a |
| Hibell <i>et al.</i> , 2004 | 2407 | Republic of Ireland | 15-16 | M: 50.6, F: 49.4 | Alcohol, BZDs, Cannabis, Tobacco | Stratified random | 10 | a |
| Hibell <i>et al.</i> , 2008 | 2221 | Republic of Ireland | 15-16 | M: 45.2, F: 54.8 | Alcohol, BZDs, Cannabis, Tobacco | Stratified random | 10 | a |
| Hibell <i>et al.</i> , 2012 | 2207 | Republic of Ireland | 15-16 | M: 50.3, F: 49.7 | Alcohol, BZDs, Cannabis, Tobacco | Stratified random | 10 | a |
| Kibir <i>et al.</i> , 2010 | 2805 | Republic of Ireland | 13-14 | M: 40.4, F: 59.6 | Tobacco | Stratified random | 8 | a |
| Kelleher <i>et al.</i> , 2003 | 2297 | Counties Clare, Limerick & Tipperary | 13-19 | M: 44.8, F: 55.3 | Alcohol, BZDs, Cannabis, Tobacco | Stratified random | 6 | a |
| Manning <i>et al.</i> , 2002 | 2580 | Republic of Ireland | 13-14 | M: 45.2, F: 54.8 | Tobacco | Stratified random | 8 | a |
| McNeill <i>et al.</i> , 2011 | 214 | Republic of Ireland | 13-15 | Unable to identify | Tobacco | Stratified random | 7 | In-home interviews |
| Moran <i>et al.</i> , 2000 | 1070 | County Louth | 12-19 | M: 100 | Tobacco | Unable to identify | 4 | a |
| Morgan <i>et al.</i> , 2007 | 1048 | Republic of Ireland | 18-24 | M: 45.9, F: 54.1 | Alcohol, BZDs, Cannabis, Tobacco | Cluster sampling | 10 | |
| O' Cathail <i>et al.</i> , 2011 | 370 | Cork city | 15-17 | M: 38.4, F: 61.6 | Tobacco | Convenience | 8 | a |
| Office of Tobacco Control, 2006 | 777 | Republic of Ireland | 8-24 | Unable to identify | Tobacco | Stratified random | 6 | |
| Palmer <i>et al.</i> , 2008 | 462 | South-east Ireland & Cork city | 14-19 | M: 45, F: 55 | Alcohol, BZDs, Cannabis | Convenience | 10 | a |
| Shaw <i>et al.</i> , 2004 | 620 | County Leitrim | 14-15 | M: 49.2, F: 50.5 | Tobacco | Randomised control trial | 5 | a, intervention study |
| Smyth <i>et al.</i> , 2011 | 133 | Republic of Ireland | 15-16 | M: 43.6, F: 56.4 | Alcohol | Simple randomisation | 8 | |
| UNICEF, 2011 | 508 | Republic of Ireland | 16-20 | Unable to identify | Alcohol, Cannabis, Tobacco | Convenience | 6 | Online survey |

M = Male, F = Female, DNS = Did not specify, BZDs = benzodiazepines, Notes: a – school(s) survey, 1 – some participants did not answer the question.

Table 2

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Table 2: Summary of smoking prevalence rates

| Study name | n | Age range (yrs) | Lifetime use of tobacco | First cigarette by 13 years | Tobacco use in the previous month | Daily tobacco use |
|---------------------------------|------|--------------------|------------------------------|--------------------------------|--|---------------------------------------|
| Cumie <i>et al.</i> , 2008 | 4840 | 11-15 | 26% (13 y.o.), 50% (15 y.o.) | 33% (female), 29% (male) | - | 3% (13 y.o.), 15% (15 y.o.) |
| Curtin, 2004 | 248 | 15-16 | 50% | - | 31% | 19% |
| Flanagan <i>et al.</i> , 2003 | 1426 | 12-19 | 50.8% | 30.2% | - | 18.2% |
| Hibell <i>et al.</i> , 2004 | 2407 | 15-16 | 67% | 45% | 33% | - |
| Hibell <i>et al.</i> , 2008 | 2221 | 15-16 | 52% | 32% | 23% | - |
| Hibell <i>et al.</i> , 2012 | 2207 | 15-16 | 43% | 21% | 21% | - |
| Kabir <i>et al.</i> , 2010 | 2805 | 13-14 | - | - | 10.6% ¹ | - |
| Kelleher <i>et al.</i> , 2003 | 2297 | 14-18 | 61.3% | 49.7% | 30.0% | - |
| Manning <i>et al.</i> , 2002 | 2580 | 13-14 | - | - | 19.0% ¹ | - |
| McNeill <i>et al.</i> , 2011 | 214 | 13-15 | - | - | 10.5-13.5% | - |
| Moran <i>et al.</i> , 2000 | 1070 | 12-19 | - | - | 39% | 22.5% |
| Morgan <i>et al.</i> , 2007 | 1048 | 18-24 | - | - | 29% (18-19 y.o.), 40% (20-24 y.o.) | 23% (18-19 y.o.), 31% (20-24 y.o.) |
| O' Cathail <i>et al.</i> , 2011 | 370 | 15-17 | 48.4% | - | 18.1% | - |
| Office of Tobacco Control, 2006 | 777 | 8-24 | - | - | 16% ² (12-17 y.o.), 42% ² (18-24 y.o.) | - |
| Share <i>et al.</i> , 2004 | 620 | 14-15 | 57% | 38% | 21% ¹ | 11% |
| UNICEF, 2011 | 508 | 16-20 | - | - | 23% | - |

Notes: 1 – Answer positively when asked if they are currently smoking, 2 - Figure represents current smokers that smoke greater than once a week or more, 3 - y.o. = year-olds

Table 3: Summary of alcohol prevalence rates

| Study name | n | Age range (yrs) | Lifetime use of alcohol | First alcohol consumption before 13 years | Alcohol use in the previous 12 months | Alcohol use in the previous month |
|-------------------------------|------|-----------------|------------------------------------|---|---------------------------------------|--|
| Currie <i>et al.</i> , 2008 | 4840 | 11-15 | - | 38% ¹ | - | - |
| Curtin, 2004 | 248 | 15-16 | 82% | - | - | 59% |
| Flanagan <i>et al.</i> , 2003 | 1426 | 12-19 | 71.3% | - | - | - |
| Hibell <i>et al.</i> , 2004 | 2407 | 15-16 | 92% | 47% (beer), 45% (wine), 32% (spirits) | 88% | 73% |
| Hibell <i>et al.</i> , 2008 | 2221 | 15-16 | 86% | 33% (beer), 31% (wine), 21% (spirits) | 78% | 56% |
| Hibell <i>et al.</i> , 2012 | 2207 | 15-16 | 81% | 40% (beer), 18% (wine), 35% (spirits) | 73% | 50% |
| Kelleher <i>et al.</i> , 2003 | 2297 | 14-18 | 90.2% | 50.2% | 83.4% | 62.4% |
| Morgan <i>et al.</i> , 2007 | 1048 | 18-24 | 84% (18-19 y.o.), 93% (20-24 y.o.) | - | - | 78.3% (18-19 y.o.), 84.5% (20-24 y.o.) |
| Palmer <i>et al.</i> , 2008 | 462 | 14-19 | 86.10% | - | 82.6% ² | 61.6% ³ |
| Smyth <i>et al.</i> , 2011 | 133 | 15-16 | 58% | - | - | - |
| UNICEF, 2011 | 508 | 16-20 | 77% | - | - | - |

Notes: 1 - only 15 y.o. reported, 2 – those who drank alcohol once a year or more often, 3 – those who drank once a month or more often, 3 - y.o = year-olds

Table 4: Summary of cannabis prevalence rates

| Study name | n | Age range (yrs) | Lifetime use of cannabis | Cannabis use in the previous 12 months | Cannabis use in the previous month |
|-------------------------------|------|--------------------|---------------------------------------|--|--|
| Currie <i>et al.</i> , 2008 | 4840 | 11-15 | 20% ¹ | 17% ¹ | 7% (female) ¹ , 11% (male) ¹ |
| Flanagan <i>et al.</i> , 2003 | 1426 | 12-19 | 31.0% | - | 12.8% |
| Hibell <i>et al.</i> , 2004 | 2407 | 15-16 | 39% | 31% | 16% |
| Hibell <i>et al.</i> , 2008 | 2221 | 15-16 | 20% | 15% | 9% |
| Hibell <i>et al.</i> , 2012 | 2207 | 15-16 | 18% | 14% | 7% |
| Kelleher <i>et al.</i> , 2003 | 2297 | 14-18 ² | 28.6% | 24.2% | 15.4% |
| Morgan <i>et al.</i> , 2007 | 1048 | 18-24 | - | 12% (18-19 y.o.), 14% (20-24 y.o.) | - |
| Palmer <i>et al.</i> , 2008 | 462 | 14-19 | 41.1% | 32.5% | 13.62% ³ |
| UNICEF, 2011 | 508 | 16-20 | >80% (weed) ⁴ , 46% (hash) | - | - |

Notes: 1 - only 15 y.o. reported, 2 - 13 and 19 y.o. were excluded due to lack of data, 3 - cannabis use once a month or more frequently, 4 - precise percentage could not be determined, 5 - y.o = year-olds

Table 5: Summary of benzodiazepine prevalence rates

| Study name | n | Age range (yrs) | Lifetime use of benzodiazepines | Lifetime use of benzodiazepines without prescription | Lifetime use of benzodiazepines on prescription |
|-------------------------------|------|-----------------|---------------------------------|--|---|
| Hibell <i>et al.</i> , 2004 | 2407 | 15-16 | - | 2.0% | 10.0% |
| Hibell <i>et al.</i> , 2008 | 2221 | 15-16 | - | 3.0% | 10.0% |
| Hibell <i>et al.</i> , 2012 | 2207 | 15-16 | - | 3.0% | 9.0% |
| Kelleher <i>et al.</i> , 2003 | 2297 | 13-19 | - | 5.6% | 9.2% |
| Morgan <i>et al.</i> , 2007 | 1048 | 18-24 | - | 0% (18-19 y.o.), 1.4% (20-24 y.o.) | 1.0% (18-19 y.o.), 1.1 (20-24 y.o.) |
| Palmer <i>et al.</i> , 2008 | 492 | 14-19 | 10.8% | - | - |

1 - y.o = year-olds

Figure 1

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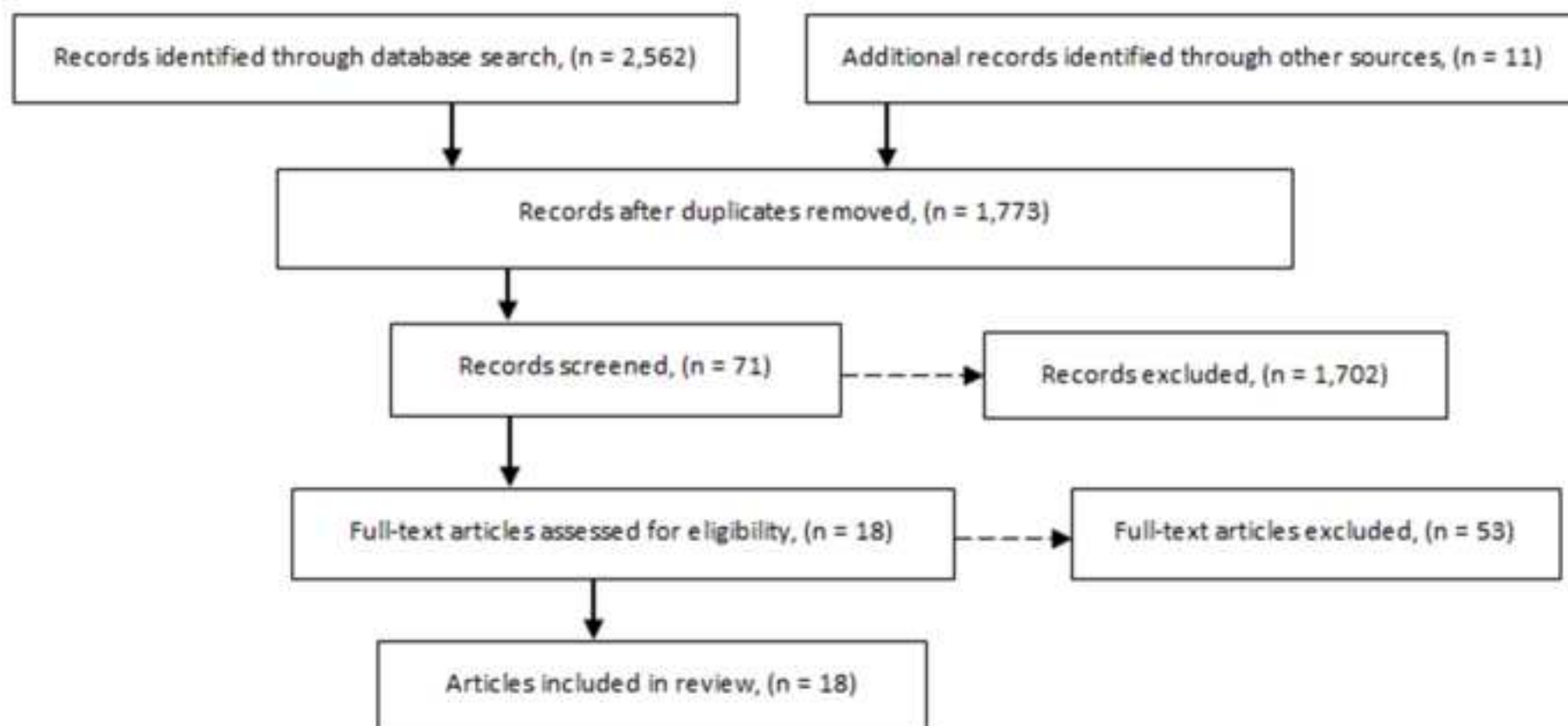


Figure 1. Adapted from the PRISMA flow diagram

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Contributors

SB, LS, and SL conceived the original idea for, and designed the review criteria. KM carried out the database searches and wrote the introduction, methods, results, discussion and conclusion. SB, LS, and SL reviewed all drafts and suggested modifications. All authors contributed to and have approved final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

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